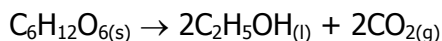


# AP Chemistry: Thermodynamics

AP Chemistry Thermodynamics WS 0809.doc

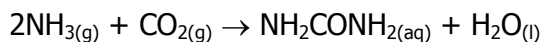
Name: \_\_\_\_\_ Date: \_\_\_\_\_ Per: \_\_\_\_\_

1. The following equation represents the essential change that takes place during the fermentation of glucose to ethanol:



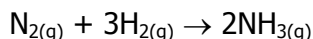
Is  $\Delta S^\circ$  positive or negative? Explain.

2. Calculate the change of entropy,  $\Delta S^\circ$ , at 25.0°C for the reaction in which urea is formed from  $\text{NH}_3$  and  $\text{CO}_2$ .

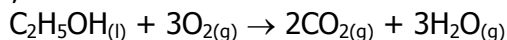


The standard entropy of urea is 174 J/molK. See the text appendices for additional values.

3. Using values of  $\Delta H^\circ_f$  and  $S^\circ$ , calculate the standard free energy change,  $\Delta G^\circ$ , for the following reaction at 25.0°C.



4. Using standard free energies of formation, calculate  $\Delta G^\circ$  for the combustion of 1 mol of ethanol,  $\text{C}_2\text{H}_5\text{OH}$ , at 25.0°C.

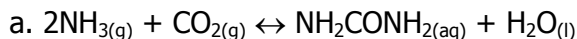


5. Calculate  $\Delta H^\circ$  and  $\Delta G^\circ$  for the reaction

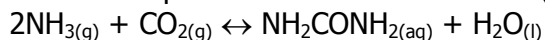


Interpret the signs obtained for  $\Delta H^\circ$  and  $\Delta G^\circ$ . Values of  $\Delta H^\circ_f$  (in kJ/mol) are as following:  $\text{KClO}_{3(s)} = -397.7$ ;  $\text{KCl}_{(s)} = -436.7$ . Similarly, values of  $\Delta G^\circ_f$  (in kJ/mol) are:  $\text{KClO}_{3(s)} = -296.3$ ;  $\text{KCl}_{(s)} = -408.8$ . Note that  $\text{O}_{2(g)}$  is the reference form of the element, so  $\Delta H^\circ_f = \Delta G^\circ_f = 0$  for it.

6. Write expressions for the "thermodynamic" equilibrium constants for each of the following reactions:

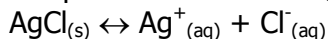


7. Find the value of the equilibrium constant K at 25°C (298K) for the reaction



The standard free energy change,  $\Delta G^\circ$ , at 25.0°C equals -13.6kJ

8. Calculate the equilibrium constant  $K_{sp}$  at 25.0°C for the reaction:



using standard free energies of formation.

9. a. What is  $\Delta G^\circ$  at 1,000.°C for the following reaction?



Is this reaction spontaneous at 1,000.°C and 1.00atm?

b. What is the value of  $K_p$  at 1,000.°C for this reaction? What is the partial pressure of  $\text{CO}_2$ ?

10. To what temperature must magnesium carbonate be heated to decompose it to MgO and  $\text{CO}_2$  at 1.00atm? Values of  $\Delta H^\circ_f$  (in kJ/mol) are:  $\text{MgO}_{(s)} = -601.2$ ;  $\text{MgCO}_{3(s)} = -1111.7$ . Values of  $S^\circ$  (in J/K) are:  $\text{MgO}_{(s)} = 26.9$ ;  $\text{MgCO}_{3(s)} = 65.9$